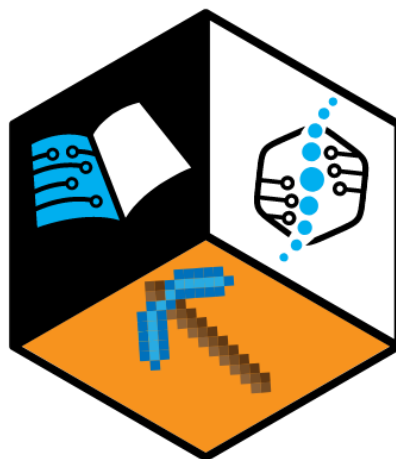


MODULE 3: NANOPARTICLES

RESULT: R1/T1.3. LESSON PLAN



NANOWARE

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Lesson 1 Information

Title: NANOTECHNOLOGY IN OUR LIVES

Subject: **The specific of Nanoparticles structures, shapes, comparing nanoparticles with more familiar everyday objects**

Grades: 9-12

Brief Description: Students will learn about how to identify nanoparticles, describing their properties and uses, understanding the importance of best practices in using nanoparticles.

Objectives: Students will be able to:

- use calculations to analyze the effect size has on the surface area to volume ratio of particles,
- link properties of nanoparticles to their uses to understand the importance of nanotechnology in society, transfer mathematics skills to express nanoparticle sizes using scientific notation and calculate volumes and ratios,
- the list of uses of nanoparticles and the associated potential risks.

Duration: The following lesson plan can last from 1 hour in a classroom of about 25 to 30 students.

Lesson Procedure

The lesson plan was created to teach more deeply about the specifics of Nanoparticles.

This lesson will help students to understand a variety of different types, sizes and shapes of nanoparticles. The teacher will explain what nanoparticles are and how to describe them. Students will learn to act about the topic proposed. They will recognize the types of nanoparticles, and understand the best practices for using nanoparticles.

Activity 1: What we know and what we don't know about nanoparticles?

Materials Needed

Computer and internet access, papers

Activity Procedure

The teacher will explain the context for students to be familiar with the topic treated. He will present to students an introductory video about what nanotechnology is.

You can automatically add subtitles in your mother language or help the students by explaining the video. You can find the video here: <https://www.youtube.com/watch?v=vvWx4KgOmGY>

This science video explains nanoparticles. Students will find the answers to the: what are nanoparticles? how small they are? Can we see nanoparticles with our naked eyes? What are the differences between bulk materials and nanomaterials? Why do different nanoparticles of the same material have different colours?

Students are provided with the material and presented with the topic of the activity. The teacher will invite students to work in small groups to create their presentation about what is specific to nanoparticles, summarizing dates from the video and what new information they find after the video presentation.

Students will be able to analyze the video message about how to identify nanoparticles, describe their properties and uses, and understand the importance of best practices in using nanoparticles.

Through this activity, participants will follow the case presentation, students will raise arguments, finding the advantages and disadvantages of learning about nanoparticles.

The teacher's role in this phase is to encourage students to express ideas, have an efficient discussion, active communication and reflection to wrap up key topics addressed in the lesson plan. Students are encouraged to express their views and their opinions.

Activity 2: STUDY CASE – Comparing Medium-Sized Nanoparticles with a Single Strand of Human Hair

Materials Needed

- Table, video projector

Activity Procedure

The teacher will invite students to debate all aspects of Comparing Medium-Sized Nanoparticles with a Single Strand of Human Hair. He will present the case and start with a few questions for the students to set up a debate and keep their audience engaged.

Human hair has a diameter of 80000 nanometers. How many nanoparticles with a diameter of 50 nanometers would fit across the human hair?

- *Human hair varies in thickness by quite a lot, but it's typically 100 micrometers wide, which is about 100000 nanometers. The particular hair we've been given is 80000 nanometers in diameter, which is just a little bit thinner.*
- *Nanoparticles are particles with a diameter of 1 to 100 nanometers, the nanoparticles we'll be using have a diameter of 50 nanometers. To figure out the number of nanoparticles we need, we simply have to take the diameter of the hair and divide it by the diameter of the nanoparticle.*
- *We plug in our values to get 80000 nanometers divided by 50 nanometers.*

The answer is 1600 nanoparticles.

Students will follow the teacher's presentation and will debate the case. They can ask questions and get clarification from their teacher before starting the exercise.



Activity 3: Brainstorming

Materials Needed

Papers to collect ideas

Activity Procedure

The teacher will present an affirmation and students are invited to explain any advantages. Students are encouraged to express their views and their opinions:

- **Constantly developing nanotechnology provides the possibility of manufacturing nanostructured composites with a polymer matrix doped with ceramic nanoparticles, including ZnO.**

In this phase, students may have discussion, communication and reflection to wrap up key topics addressed. The teacher will invite students to debate all aspects of the activities described, encouraging students to express ideas, prior knowledge and questions about the topic, while promoting interaction and communication between them.

In the conclusion phase, the main points, answers, results and steps are summarized.

Lesson 2 Information

Title: NANOTECHNOLOGY IN OUR LIVES

Subject: **The specific of Nanoparticles structures, shapes, comparing nanoparticles with more familiar everyday objects**

Grades: 5-8

Brief Description: Students will learn about how to identify nanoparticles, describing their properties and uses, understanding on the importance of best practices in using nanoparticles.

Objectives: Students will be able to:

use calculations to analyze the effect size has on the surface area to volume ratio of particles,

link properties of nanoparticles to their uses to understand the importance of nanotechnology in society,

transfer mathematics skills to express nanoparticle sizes using scientific notation and calculate volumes and ratios,

list uses of nanoparticles and the associated potential risks.

Duration: The following lesson plan can last from 1 hours in a classroom of about 25 to 30 students.

Lesson Procedure

The lesson plan was created to teach more deeply about the specifics of Nanoparticles.

This lesson will help students to understand a variety of different types, sizes and shapes of nanoparticles. The teacher will explain what nanoparticles are and how to describe them. Students will learn to take action about the topic proposed. They will recognize the types of nanoparticles, and understand the best practices for using nanoparticles.

Activity 1: What we know and what we don't know about nanoparticles?

Materials Needed

Computer and internet access, papers

Activity Procedure

The teacher will explain about Nanoparticles – uses and risks and about the context for students to be familiar with the topic treated. He will present to students an introductory video about what nanotechnology is.

- You can automatically add subtitles in your mother language or help the students by explaining the video. You can find the video here: <https://www.youtube.com/watch?v=70dOzvhn-8M>

This video covers:

- What nanoparticles are and why they're useful
- The uses of nanoparticles e.g. as catalysts, in nano-medicine, and in electrical circuits
- The risks of nanoparticles

- How silver particles are used in suncreams and the possible health risks

Students are provided with the material and presented with the topic of the activity. The teacher will invite students to work in small groups to create their presentation about what is specific to nanoparticles, summarizing data from the video and what new information they find after the video presentation.

Students will be able to analyze the video message about Nanoparticles – uses and risks, analyzing the importance of best practices in using nanoparticles. They are encouraged to express their views and their opinions.

Through this activity, participants will follow the case presentation, students will raise arguments, finding the advantages and disadvantages of learning about nanoparticles.

The teacher's role in this phase is to encourage students to express ideas, have an efficient discussion, active communication, and reflection to wrap up key topics addressed in the lesson plan.

Activity 2: STUDY CASE – Why are Nanoparticles special?

Materials Needed

- Table, video projector

Activity Procedure

The teacher will invite students to find arguments to debate a case: *What things make a nanoparticle special?*

He will start with a few explanations for the students to set up a debate and keep their audience engaged. There are many, many types of nanoparticles, and some of them have very unusual structures.

Let's imagine we've got a sugar cube that is one centimetre along each side; the volume of the cube is one centimetre multiplied by one centimetre, one centimetre cubed. A cube has six faces, and each face is one centimetre by one centimetre; the total surface area is six centimetres squared, with a surface-area-to-volume ratio of six squared centimetres for each cubic centimetre. For the same volume, the same amount is 100 nanometers by 100 nanometers by 100 nanometers, using exactly the same amount of material.

It has the same volume, but each particle has a much more exposed surface. The total surface area is 600000 centimetres squared, a surface area that's 100000 times bigger.

The teacher's role will be to invite students to encourage students to express ideas, prior knowledge and questions about the topic while promoting interaction and communication between them.

Students will follow the teacher's presentation and will debate the case. They can ask questions and get clarification from their teacher before starting the exercise.

Through this activity, participants will follow the case presentation, students will raise arguments, finding the advantages and disadvantages of learning about nanoparticles.

Activity 3: Brainstorming

Materials Needed

Papers to collect ideas

Activity Procedure

The teacher will present an affirmation and students are invited to explain any advantages. Students are encouraged to express their views and their opinions.

Let's identify the advantages of affirmation:

Nano-treating, by adding a low loading of ceramic nanoparticles into a metal matrix, can effectively reduce the hot cracking susceptibility of aluminum alloys during solidification processes such as casting, welding, and additive manufacturing.

The teacher will invite students to debate all aspects of the activities described, encouraging students to express ideas, and promoting interaction and communication between them. In this phase, students may have discussion, communication and reflection to wrap up key topics addressed.

In the conclusion phase, the main points, answers, results and steps are summarized.